

# Choledochoduodenostomy

## *Analysis of 71 Cases Followed for 5 to 15 Years*

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To investigate the long-term effectiveness of choledochoduodenostomy (CDD), the experience with 71 patients followed for 5 or more years after CDD was analyzed retrospectively. From 1968 to 1984, 134 patients underwent CDD. Eight patients (6%) died in the immediate postoperative period, 55 left the hospital, 8 of them were lost to follow-up, and 47 were followed but died before 5 years elapsed after CDD. The remaining 71 patients form the data base for this analysis: 38 were followed for more than 5 years, 25 were followed for more than 10 years, and 8 were followed for more than 15 years ( $\bar{x}$  12.1 years  $\pm$  1.3 SEM). Choledocholithiasis, chronic pancreatitis, and postoperative stricture were the indications for CDD. Cholangitis was observed in only three patients. The diameter of the common bile duct (CBD) was large in most patients ( $\bar{x}$  18 mm  $\pm$  0.9 SEM). These results infer that CDD is effective to treat non-neoplastic obstructing lesions of the distal CBD on a long-term basis and that the presence of a dilated CBD (more than 16 mm) that allows the construction of a CDD more than 14 mm is essential to obtain good results.

**I**N THE PAST decade, written communications about choledochoduodenostomy (CDD) have appeared with increasing frequency in journals published in the United States. Most of them are from American surgeons<sup>1-9</sup> documenting their increasing interest and factual experience with this procedure. There are also several series of CDD analyzed by surgeons from Europe,<sup>10-15</sup> Israel,<sup>16-18</sup> and Latin America.<sup>19</sup> With all this information, the indications for constructing a CDD to treat obstructions of the distal common bile duct (CBD) have been better defined.

Furthermore the advantages offered by this procedure, as well as its risks and disadvantages, also have been well noted in most of the already quoted bibliographic refer-

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ences. However, with two exceptions,<sup>12,20</sup> the long-term results of CDD, particularly in reference to the incidence of complications such as cholangitis and the 'sump syndrome,' have not been documented clearly.

This review analyzes the results observed in a group of patients who underwent CDD, mostly for non-neoplastic obstructive lesions of the distal CBD, who were followed for a minimum of 5 years.

### Materials and Methods

The records of all patients who had an anastomosis surgically constructed between the common hepatic bile duct (CHBD) or the CBD and the first or second portion of the duodenum during a period of 17 years from 1968 to 1984 at the University of Alabama and Veterans Administration Hospitals were reviewed retrospectively. There were 134 such patients. Eight of them (6%) died after operation; the other 126 patients left the hospital alive but eight of them (6%) were lost to long-term follow-up. The remaining 47 (35%) died 6 or more months after their CDD. The remaining subgroup of 71 patients was followed for 60 or more months. They were alive at the time of completion of this study (January 1990) and constitute its patient data base (Fig. 1). Most of them were followed as outpatients with regularly scheduled visits every 6 to 12 months. At the time of this study, the information was updated by personal interview or *via* telephone in 59 patients, and with their relatives in the other 12. The usual statistical methods were used to determine the likelihood that the differences were due to chance.

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## Choledochoduodenostomies UAB &amp; VA Hospital 1968-1984

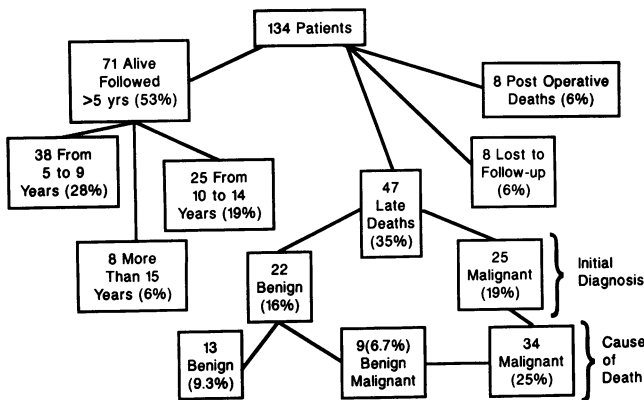


FIG. 1. Outcome of 134 patients who underwent choledochoduodenostomy. The 71 who survived 5 or more years comprise the patient data base of this analysis.

### Results

#### Main Patient Data Base (Cases Followed for 5 or More Years)

Of the 71 patients who survived CDD for 5 or more years, 37 are men (52.1%) and 34 are women (47.9%); their ages ranged from 21 to 95 years ( $\bar{x}$  59.5  $\pm$  2.0 years SEM).

Depending on the length of their follow-up period after CDD, these patients were categorized as follows: group A, followed from 5 to 9 years; group B, followed from 10 to 14 years; and group C, followed for 15 or more years (Table 1). The indications for the CDD were choledocholithiasis in 40 (56.3%), chronic pancreatitis with choledocholithiasis in 9 (12.7%), chronic pancreatitis without choledocholithiasis in 14 (19.7%), and postoperative strictures in 8 (11.3%). An elevated level of total bilirubin in serum (more than 1.5 mg/100 mL) was found in 61 patients (86%). The levels of alkaline phosphatase in serum ranged from 53 to 910 international units (IU) ( $\bar{x}$  567  $\pm$  2.8 SEM). The diameter of the common bile duct, as recorded in the operative note, ranged from 8 to 47 mm ( $\bar{x}$  18 mm  $\pm$  0.9 SEM). This information is categorized by groups in Table 2.

The technical variations of the CDD were side-to-side (S-S) in 67 patients (94.3%) and end-to-side (E-S) in four patients (5.7%). In six of these cases (8%), the main hepatic duct rather than the CBD was used (Table 3). In only two cases (2.8%), a tubular stent was left through the CDD.

There were 22 complications observed in 20 patients (28%) within the 30 days following operation. Wound infection that occurred in eight (11%) was the most common. The other observed postoperative complications are summarized in Table 4.

There were three cases (4.2%) of proved cholangitis documented by fever of more than 38° C, associated with chills, elevated total bilirubin (more than 4 mg/dl), and elevated alkaline phosphatase (more than 200 IU). All of these three patients survived their CDD 15 or more years (group C) and their episodes of cholangitis warrant description. The first patient underwent CDD in 1971 to correct a postoperative stricture of the CBD; the constructed CDD measured only 12 mm in diameter. Five years after operation in 1976, she had two episodes of cholangitis that lasted 2 and 4 days, respectively. She was treated with intravenous antibiotics and never again developed signs or symptoms of bacterial cholangitis; she remains well in 1990.

The second patient has been followed since 1972. He required a CDD that was 10 mm in diameter to correct a stricture of the CBD secondary to an operative injury. Two years later he developed an active duodenal ulcer that partially obstructed the CDD resulting in jaundice, fever and chills. The duodenal ulcer was treated medically and the signs and symptoms of cholangitis subsided. In the subsequent 15 years, this patient had 21 similar episodes; the last one in 1989 persisted for 2 weeks and was due to fibrous stenosis of the CDD, assumedly from the multiple process of healing the duodenal ulcer that always occurred next to the CDD. This was resolved with the insertion of a metallic expandable stent placed percutaneously. This patient has remained asymptomatic for the last 5 months.

The third patient was operated on in 1973 at age 29 years with the presumptive diagnosis of choledocholithiasis. At operation she was found to have sclerosing chol-

TABLE 1. Demographics of 71 Patients Who Underwent Choledochoduodenostomy and Were Followed for More than 5 Years

Group	Follow-up (years)	Mean Follow-up (years)	No. of Pts.	Sex		Mean Age (years $\pm$ SEM)
				M	F	
Group A	5-9	7.3 $\pm$ 1.1*	38 (53.5)†	22 (58)	16 (42)	61 $\pm$ 2.7
Group B	10-14	12.3 $\pm$ .85	25 (35.2)	11 (44)	14 (56)	58 $\pm$ 4.1
Group C	>15	16.5 $\pm$ .2	8 (11.3)	4 (50)	4 (50)	56 $\pm$ 7.1
Total		12.1 $\pm$ 1.3	71 (100)	38 (53.5)	34 (46.5)	59 $\pm$ 2.2

\*  $\pm$  SEM, standard error of the mean.

† Percentage.

They are categorized in three groups A, B and C, depending on the length of their follow-up period.

TABLE 2. Indications for Choledochoduodenostomy and Estimated Diameter of the Common Bile Duct Recorded at the Time of Operation

Group	CBD Lithiasis	Lithiasis and CP	Chronic Pancreatitis	Postoperative Stricture	Mean Diameter of CBD
Group A (n = 38)	23 (60.5)	2 (5)	10 (26.3)	3 (7.9)	18* ± 1.2†
Group B (n = 25)	14 (56)	6 (24)	2 (8)	3 (12)	21 ± 0.8
Group C (n = 8)	3 (37.5)	1 (12.5)	2 (25)	2 (25)	14 ± 0.7
Total (n = 71)	40 (56.3)	9 (12.7)	14 (19.7)	8 (11.2)	18 ± 0.9

\* mm.

† ± standard error of the mean.

CP, chronic pancreatitis.

Numbers in parentheses are percentages.

angitis proved by biopsy and a CDD that measured 12 mm was constructed. Six months later she began to have episodes of cholangitis with fever and chills that were treated with oral and intravenous antibiotics. She eventually died in 1988 from liver failure; there were 35 recorded episodes of cholangitis for this patient.

Although at the time of construction of the CDD choledocholithiasis was found in 49 patients (69%), recurrent choledocholithiasis was not apparent in any of the 71 cases analyzed. In 40 patients (56%), cholecystectomy was done at the time of the CDD. In the remaining 31 cases (44%), the gallbladder had been removed previously. In 26 patients (84%) of this subgroup with absent gallbladders at the time of CDD, biliary calculi were removed from the lumen of the CBD; choledocholithiasis was not found in 5 patients (16%) from this group. A stenotic ampulla of Vater, as judged by the the operating surgeon's inability to pass a calibrated dilator size 3 mm or larger into the duodenum, was found in 68 (96%) of the 71 patients. All of the three patients in whom ampullary stenosis was not found had cholecystectomy before the CDD.

#### Patients Not Followed for More Than 5 Years

**Postoperative deaths.** Eight patients died in the hospital during the same hospitalization for their CDD. Five of them were operated on because of malignant neoplastic diseases of the pancreas and the bile ducts and they died of postoperative complications. In two patients, the CDD was done as a desperate attempt to reconstruct their biliary system that had been injured in previous operations per-

formed at other hospitals; both of these patients had subhepatic abscesses; both died of sepsis and multiple-organ system failure.

The remaining patient was operated on for acute cholecystitis and choledocholithiasis and had advanced cardiovascular disease with severe coronary artery occlusive disease. She died on the seventh postoperative day of intractable arrhythmias. The demographics, the initial diagnosis, and the cause of death for these patients are shown in Table 5.

**Patients lost to follow-up.** Despite a persistent search, there were eight patients in whom adequate long-term follow-up could not be obtained. Six of them had been operated on at the Birmingham Veterans Administration Hospital and shortly after their operation moved to another state. Their records were removed from our Veterans Administration Hospital and subsequently could not be located. All of these six patients left the hospital in good conditions with normal liver function tests, so it is presumed that their operation was initially successful.

Two other patients were operated on at the UAB Hospital; one was free of symptoms on an outpatient visit 5 months after CDD, but subsequent follow-up could not be obtained. The other patient left the hospital in good condition on the eighth postoperative day and was lost to follow-up. The details of these eight patients are summarized in Table 6.

TABLE 3. Type of Anastomosis Used in 71 Cases of Choledochoduodenostomies\* Followed for 5 or More Years

Group	Side-Side (S-S)	End-Side (E-S)
Group A	36	2
Group B	24	1
Group C	7	1
Total	67	4

\* Six hepaticoduodenostomies are included.

S-S, 1.

E-S, 5.

TABLE 4. Postoperative Complications Other than Cholangitis Observed in 71 Patients with Choledochoduodenostomies

Specific Complications	Group A	Group B	Group C	Total
Pneumonia	1	—	1	2 (2.7%)
Atelectasis	—	3	—	3 (4.1%)
GI bleeding	—	—	1	1 (1.4%)
Pancreatic fistula	1	—	—	1 (1.4%)
Biliary fistula	1	—	—	1 (1.4%)
Postoperative fever	1	—	—	1 (1.4%)
Wound infection	5	3	—	8 (11.1%)
UT infection	2	2	—	4 (5.6%)
Rash	—	1	—	1 (1.4%)
Total	10	9	3	22

GI, gastrointestinal; UT, urinary tract.

TABLE 5. Demographics, Diagnosis, and Cause of Death of Eight Patients Who Died After Choledochoduodenostomy

Patient	Age (years)	Sex	Death PO Day	Initial Diagnosis	Cause of Death
1	64	M	7	Acute cholecystitis and CBD stones	Arrhythmia
2	39	F	55	Postop stricture	Sepsis, MOSF
3	61	F	17	Postop stricture	ARDS
4	29	M	9	Pancreatic carcinoma	DIC
5	65	M	12	Chronic pancreatitis and pancreatic carcinoma	ARDS
6	57	F	10	Cholangiocarcinoma	Sepsis, MOF
7	86	F	18	Pancreatic carcinoma	ARDS
8	66	F	12	Pancreatic carcinoma	Liver failure

MOSF, multiple-organ systems failure.  
ARDS, adult respiratory distress syndrome.

DIC, disseminated intravascular coagulation.  
PO, postoperative.

**Late deaths.** Of the remaining 47 patients (35%), the initial diagnosis of benign disease was made in 22 and of a malignant neoplastic process in 25. All of the 47 patients died 3 to 58 months after their CDD ( $\bar{x}$  16.5 months  $\pm$  2.3 SEM). In 34 patients the cause of death appeared to be directly related to a malignant neoplasm, which included pancreatic carcinoma in 29, ampullary carcinoma in 1, colonic carcinoma in 1, Hodgkin's lymphoma in 1, prostate carcinoma in 1, and cholangiocarcinoma in 1. The mean survival period in these 34 patients was  $\bar{x}$  0.9 years  $\pm$  3 SEM. It should be noted that nine patients initially coded as having benign disease at the time of their CDD subsequently died from carcinoma. Therefore we could speculate that in some of these patients, particularly those who had carcinoma of the pancreas, the tumor was present at the time of CDD but was not detected. Further details of these nine patients are shown in Table 7.

The remaining 13 patients in whom CDD was done for a benign disease recovered uneventfully and the CDD relieved their symptoms; however they died of unrelated

causes before 5 years had elapsed from the time of the CDD. Further details of these patients are shown in Table 8.

#### Number of Surgeons Performing the Choledochoduodenostomies

There were 10 surgeons who performed the 134 choledochoduodenostomies reported herein; however 93.25% of these cases were performed by only four surgeons. The two senior authors of this study performed 78.25% of these 134 cases. The same four surgeons performed 94.4% of them, and the same two surgeons operated in 86% of the 71 cases followed for 5 or more years.

#### Discussion

The historical development of CDD was summarized by Madden and associates<sup>21</sup> in 1970. The first published experience with CDD by an American surgeon was by R. L. Sanders from Memphis, Tennessee, a member of the Southern Surgical Association from 1921 to 1964. He presented his work in the 57th Annual Meeting of this Association in December 1945. His paper was published in the *Annals of Surgery* in 1946.<sup>22</sup> He described his experience with side-to-side CDD in 25 patients. Nineteen of them had benign obstructive lesions and six had malignant obstructive lesions; only two of his patients died (8%). He noted that 15 patients were living and well many months after the operation. He commented on the effectiveness of CDD to relieve distal obstruction of the CBD and the importance of having a largely dilated CBD as a requirement for good long-term results with CDD.

Despite these favorable results, there was no great enthusiasm in the United States for CDD; the only two large series published in the subsequent 20 years by American surgeons were by Schwartz, Benshimol, and Hurwitz in 1959<sup>23</sup> and by Madden and associates in 1965.<sup>24</sup> In 1967

TABLE 6. Eight Patients Lost to Follow-up

Patient	Age (years)	Sex	Hospital	Last Seen After CDD (days)	Condition
1	60	M	V.A.	24	Good
2	58	M	V.A.	30	Good
3	75	M	V.A.	7	Good
4	74	M	V.A.	60	Good
5	48	M	V.A.	12	Good
6	68	M	V.A.	30	Good
7	59	M	U.A.B.	150	Good
8	71	M	U.A.B.	8	Good

All recovered satisfactorily from choledochoduodenostomy and in the short follow-up period the goals of the operation appeared to have been obtained.

CDD, choledochoduodenostomy.

VA, Veterans Administration hospital in Birmingham.

UAB, University of Alabama at Birmingham Hospital.

TABLE 7. Nine Patients with Initial Diagnosis of Benign Disease, but Subsequently at the Time of Death Were Found to Have a Carcinoma

Patient	Age (years)	Sex	Initial Diagnosis	Cause of Death	Survival Period After CDD (months)
1	63	M	CBD lithiasis	Cholangiocarcinoma*	29
2	70	M	CP	Lung metast./unknown prim.	12
3	60	M	CP	Ampullary Ca*	24
4	76	M	CBD lithiasis	Ca. pancreas and metast.*	36
5	60	M	CP	Ca. pancreas and metast.*	14
6	79	M	CBD lithiasis	Prostate carcinoma	14
7	54	F	CP	Colon carcinoma	48
8	53	M	CP	Ca. pancreas and metast.*	6
9	52	F	CP	Ca. pancreas and metast.*	13

\* Six patients could have had their carcinoma at the time of choledochoduodenostomy (CDD), but it was not detected.

CP, chronic pancreatitis; Ca, carcinoma; Metast, metastases.

Hurwitz and Degenshein published a reappraisal article<sup>25</sup> in which they explained the technical details that determine the success of side-to-side CDD. It should be stated that after the pioneering work of Sanders, Madden<sup>21,24</sup> and Hurwitz<sup>23,25</sup> have been the most avid American advocates of CDD and the wider use of this operation in the United States is due, to a great extent, to their excellent results and persistent enthusiasm for CDD.

The European literature in the past three decades contains a number of publications,<sup>26-34</sup> and a recent report from Latin America<sup>35</sup> carefully evaluates the results, indications, advantages, complications, and shortcomings of CDD; the general consensus is that choledochoduodenostomy is a very satisfactory surgical procedure to treat a variety of obstructing lesions of the distal CBD. Most of these authors stipulate that the diameter of the CBD used for constructing the CDD should be dilated and measure at least 15 mm.

Subsequent to the publications of Madden<sup>21,24</sup> and Hurwitz,<sup>23,25</sup> some American surgeons began to analyze and publish their experience with CDD. Thomas and associates<sup>36</sup> in 1971 and a group from the Cleveland Clinic<sup>37,38</sup> published their experience in the early 1970s; they concluded that CDD had a favorable role to play in various conditions obstructing the CBD. Degenshein et al.,<sup>39</sup> who continued the work of Alfred Hurwitz with CDD in the Maimonides Medical Center in New York, published in 1974 their analysis of their 18-year experience with 175 consecutive CDDs and concluded that it was a safe and effective operation for varied indications. This author was one of the first to show data to prove that the major objection held by some surgeons against CDD, mainly ascending infection from reflux of duodenal contents into the biliary tree, causing recurrent cholangitis, was not a problem as long as the diameter of the CBD used to construct the CDD measured at least 16 mm.

TABLE 8. Late Deaths After CDD for Nonmalignant Disease

Patient	Age (years)	Sex	Initial Diagnosis	Cause of Death	Survival After CDD (months)
1	38	M	CP	Subdural hematoma	53
2	81	M	CP	Stroke	12
3	48	M	CP	Unknown	24
4	53	F	CP	Unknown	48
5	87	M	CBD lithiasis	Stroke	24
6	87	M	CBD lithiasis	Heart failure	10
7	46	M	CP	Myocardial infarct	58
8	33	F	CBD lithiasis	Peritonitis and liver abscess	24
9	58	M	CBD lithiasis	Myocardial infarct	24
10	56	F	CBD lithiasis and CP	Nonrelated abdominal surgery and sepsis	8
11	84	M	CBD lithiasis	Heart failure	24
12	85	M	CBD lithiasis	Myocardial infarct	20
13	65	F	CP	Upper GI bleeding	20

$\bar{x}$  26  $\pm$  1.5 SEM

CDD, choledochoduodenostomy; CP, chronic pancreatitis; GI, gastrointestinal.

$\pm$ SEM, standard error of the mean.

Rutledge<sup>40</sup> also reported favorable results using CDD to treat patients with benign biliary obstruction. Gliedman and associates<sup>41</sup> in 1978 published their favorable experiences with CDD, but more importantly emphasized this operation as an adjunct to choledocholithotomy to prevent recurrent choledocholithiasis.

From the results obtained in most of the references quoted above, it can be stated that in 1990 choledochoduodenostomy is an established operation to treat successfully a variety of obstructive lesions of the distal biliary system. Furthermore, under the appropriate circumstances, it is a realistic and perhaps even a better option for closing the CBD, either primary or over a T tube, after choledocholithotomy. The morbidity and mortality rates when CDD is done for the proper indications, when the diameter of the CBD used measures 16 mm or more, and the technical precautions (mobilization of the duodenum, vertical incision in the CBD, and meticulous and precise suture techniques) have been followed, have been better or comparable to other alternative operative methods.

Because of concern about long-term results in patients with CDD, particularly with reference to the occurrence of cholangitis and of the 'sump syndrome,' the prevalent thinking among most surgeons has been that CDD should be performed only in elderly patients and that it should be avoided in younger patients who have a life expectancy of 10 or more years.

The principal aim of this study was to analyze the results obtained with CDD in patients followed for 5 or more years and to determine the safety of this operation in patients who have life expectancies of 15 or more years after CDD. Only two previous communications<sup>12,20</sup> describe the results obtained with CDD on a long-term basis; however, when analyzed closely, the details of how long these patients were followed are limited. Only 26 patients were followed 5 or more years in the series of Cuschieri and associates,<sup>12</sup> and there is no reference to patients followed 10 or more years. The other report by Baker, Neoptolemos, and others,<sup>20</sup> a group with vast experience with CDD, presents a detailed and thorough study of 190 patients who underwent CDD. In this series there were 10 postoperative deaths (5.3%) and 35 late deaths (18%) (9 to 48 months). Of the remaining 145 patients, 114 could be closely followed; the subjective evaluation was that 88% of the 125 patients followed for an unspecified 'long-term period' obtained significant benefits from their CDDs. Five of these patients required a second operation to correct a sump syndrome.<sup>42</sup> Recurrent CBD stones were found in three of these nine patients.

The present investigation followed 71 patients for at least 5 years; 38 of them (53.5%) were followed from 5 to 9 years; 25 (35.3%) from 10 to 14 years, and 8 (11.2%) for 15 or more years, with a total average follow-up of  $12.1 \pm 1.2$  years SEM. This experience suggests that when performed electively in the absence of infection in the

sub-hepatic space or unresectable malignant neoplasms, CDD can be performed successfully with a minimal mortality rate (less than 1%).

The analysis of the short-term survivors of this study also suggests that choledochoduodenostomy was remarkably free of complications. A distressing finding, however, was that nine patients thought to have benign non-neoplastic disease at the time of CDD eventually died from malignant disease, clearly pointing out the difficulty in excluding the possibility of the presence of a carcinoma in patients with biliary obstruction due to chronic fibrous pancreatitis. The fact that in some of these patients the carcinoma was not obvious until many months after CDD suggests that carcinoma coexists in patients with chronic pancreatitis, particularly those who develop biliary obstruction.

It is worth noting that of the 40 patients in whom cholecystectomy was performed at the same time as CDD, only 23 (58%) had choledocholithiasis; but in all 40 patients, stenosis of the ampulla was recorded, suggesting that ampullary stenosis may play an important role in symptomatic biliary tract disease with or without choledocholithiasis, particularly after the gallbladder has been removed.

The morbidity of CDD observed in this study (28%) as well as the type of observed complications parallels those previously reported in the literature. Perhaps the most important aspect of this study is the low incidence of cholangitis observed in the 71 patients followed for 5 or more years ( $\bar{x}$   $12.1 \pm 1.3$  years, SEM). The fact that the majority of the cases reported in this study were operated on by two surgeons suggests that experience with CDD improves the results. There were no cases of recurrent choledocholithiasis in this series and none of the patients had symptoms suggesting the presence of the so called 'sump syndrome.'

The review of the pertinent literature and the observations of the present study suggest that the indications for CDD remain very much the same as those detailed by Degenshein<sup>39</sup> in 1974. These indications are detailed below.

**Multiple Stones:** Multiple stones removed from the CBD with the concomitant uncertainty if all the calculi have been removed, even with the assistance of a postexploratory cholangiogram, usually through a T tube is one indication.

**Ampullary Stenosis:** Ampullary stenosis, as defined by the inability to pass a calibrated dilator of 3 mm or more in diameter, probably sets up the circumstances for the subsequent development of recurrent choledocholithiasis or a variety of symptoms related to this partial obstruction to the flow of bile into the duodenum. Choledochoduodenostomy appears to offer a definitive solution to these problems, as well as the

elimination of recurrent choledocholithiasis, as was the case in this series. When the surgeon is unable to pass the dilator into the duodenum and the intraoperative cholangiogram shows little or no flow of the dye into the duodenum, the possibility of an impacted stone at or near the ampulla, or in a duodenal diverticulum in the same area is real. Despite a number of maneuvers, it is difficult to determine with certainty if this is truly an impacted stone or just ampullary stenosis. Persistence in removing the impacted stone or passing a dilator into the duodenum are blind maneuvers that have a high risk of producing a 'false passage' perforation of the wall of the intrapancreatic portion of the CBD or of traumatizing the pancreas, which can lead to severe acute pancreatitis. Under such circumstances, particularly in the presence of a dilated CBD, a CDD is a definitive, safe, and completely satisfactory solution to these problems.

**Pancreaticholangiopathy:** Obstruction of the distal CBD by chronic fibrous pancreatitis is a difficult problem that can be resolved by CDD. It must be noted that the elimination of the possibility of carcinoma being a co-existing cause of the obstruction is not possible, and in this study nine patients who at the time of CDD were thought to have nonmalignant obstruction subsequently died of carcinoma.

**Malignant Neoplasms:** Obstruction of the intrapancreatic CBD by malignant neoplasms that can originate in the ductal epithelium of the pancreas, the mucosa of the CBD, the ampulla, or the duodenum near the ampulla, and that are not resectable, can be palliated effectively with a CDD. However, in many instances, the rapid growth of these tumors results in subsequent obstruction of the CDD or even the displaced duodenum; thus CDD in these circumstances should be performed only when other types of palliative decompression, which would use a segment of the biliary tree further away from the tumor and that do not require mobilization of the duodenum, cannot be done.

**Postoperative Biliary Stricture:** Unfortunately we still see these types of problems, although it appears to be much less frequent. In most of the cases, when the injury is not discovered at the time it occurs, the distal CBD becomes unsuitable for use in the reconstruction.<sup>43</sup> The alternatives, depending on the anatomic determinants, are reconstruction by anastomosis of the CHBD or the CBD to the duodenum, or to a defunctionalized loop (Roux-Y) of jejunum. When a CDD is constructed, good long-term results can be achieved, as was the case in eight patients in this series.

**Avoiding Use of T Tubes:** Finally another indication not widely accepted as yet is to construct a CDD when a CBD that measures more than 16 mm in diameter has been explored and one or more of the previously noted indications are not always present, but the conventional

methods of closing the choledochotomy over a T tube or primarily are not desirable. Some theoretical disadvantages to using T tubes<sup>44</sup> and even less satisfactory results<sup>45</sup> have been reported. It is somewhat of a 'surgical paradox' to close a choledochotomy with great precision and then 6 to 10 days later blindly pull out the T tube, which probably disrupts the closure, although it is undeniable that thousands of cases treated this way have had a very low incidence of complications. To many surgeons, including ourselves, the construction of a CDD avoids this 'surgical paradox,' obviates the need for the use of a T tube, and nearly eliminates the risk of recurrent or residual choledocholithiasis. Therefore it appears to be logical to offer CDD as a very good alternative to the use of T tubes in patients with dilated CBDs.

The two most notable objections to CDD, the possibility of cholangitis<sup>46-48</sup> and the presence of the symptoms produced by the so called 'sump syndrome,'<sup>44,47,48</sup> occur almost always in instances in which the CDD was constructed for the wrong indications, or when the CBD of these patients measured less than 16 mm in diameter, resulting in a CDD that measures less than 14 mm in length. The long-term observations of this study objectively disprove these objections to CDD as long as the proper precautions are observed. Analysis similar to this study of an adequate number of patients followed from 5 to 15 years after transduodenal sphincteroplasty or transendoscopic papillectomy will be required to determine whether those procedures offer similar or better results than those obtained with CDD. Such studies are notably absent from the current literature.

From the observations made in this study, the following inferences can be made: CDD produces good long-term results in the treatment of non-neoplastic obstructing lesions of the distal common bile duct. The size of the CBD is of critical importance in obtaining good long-term results. The diameter of the CBD should be at least 16 mm to allow the construction of a CDD that measures at least 14 mm in length. Meticulous and precise suturing techniques are essential. Intrabiliary stents are not necessary under these circumstances. Extensive technical experience in performing CDD is also an important consideration in assuring good results. If these precautions are observed, cholangitis and symptoms related to the 'sump syndrome' do not occur, or occur very infrequently. In the absence of local sepsis and under elective circumstances, CDD can be performed with very low rates of morbidity and mortality.

Because of the documented good results we have obtained in the patients reported herein followed for 5 to 15 or more years ( $\bar{x}$  12.1  $\pm$  1.3 years, SEM), the notion that CDD should be reserved only for elderly patients with limited (less than 10 years) life expectancy should

be revised, and much younger patients who have a longer life expectancy should be considered as viable candidates for CDD under appropriate circumstances.

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